Test infrastructure operational

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Table of contents

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1. Introduction

This document report combines the available test infrastructure in the C-Roads partner Members States. There are four main test areas available within C-Roads (Austria, France, Germany, the Netherlands).As infrastructure and vehicle components are developed by different manufacturers, test sessions were organised by the four Member States.
In addition the test infrastructure operational report gives an overview about the procurement status of the single C-Roads pilots by September 2017. With this report a clear picture in which direction the Member States are going should be given.

Figure 1: C-Roads pilot sites (Status 09/2017)

2. Test infrastructure available in C-Roads partner Member States

Austria (Eco-AT)

Austria has deployed a fully operational C-ITS test infrastructure called the “ECo-AT Living Lab” around the city of Vienna and its three main motorways (A23, S1, A4). A central ITS station and 24 roadside ITS stations (5 of them traffic lights) are sending out all ECo-AT use cases permanently. Overall around 50 different messages are continuously sent and monitored by these stations. The message set includes DENM (Roadworks Warning and Hazardous Location / Event Warnings), CAM (CAM Protected Zones and CAM Aggregation), IVI (In-Vehicle Signage) and SPATEM / MAPEM messages. The installations are operated by the ECo-AT industry partners Kapsch TrafficCom, Siemens and Swarco on the ASFINAG network. Testing activities in the Living Lab have to be announced in advance to ASFINAG and all three industry partners in order to have full functionality and test support. A detailed storyboard depicting all messages in more detail is available.

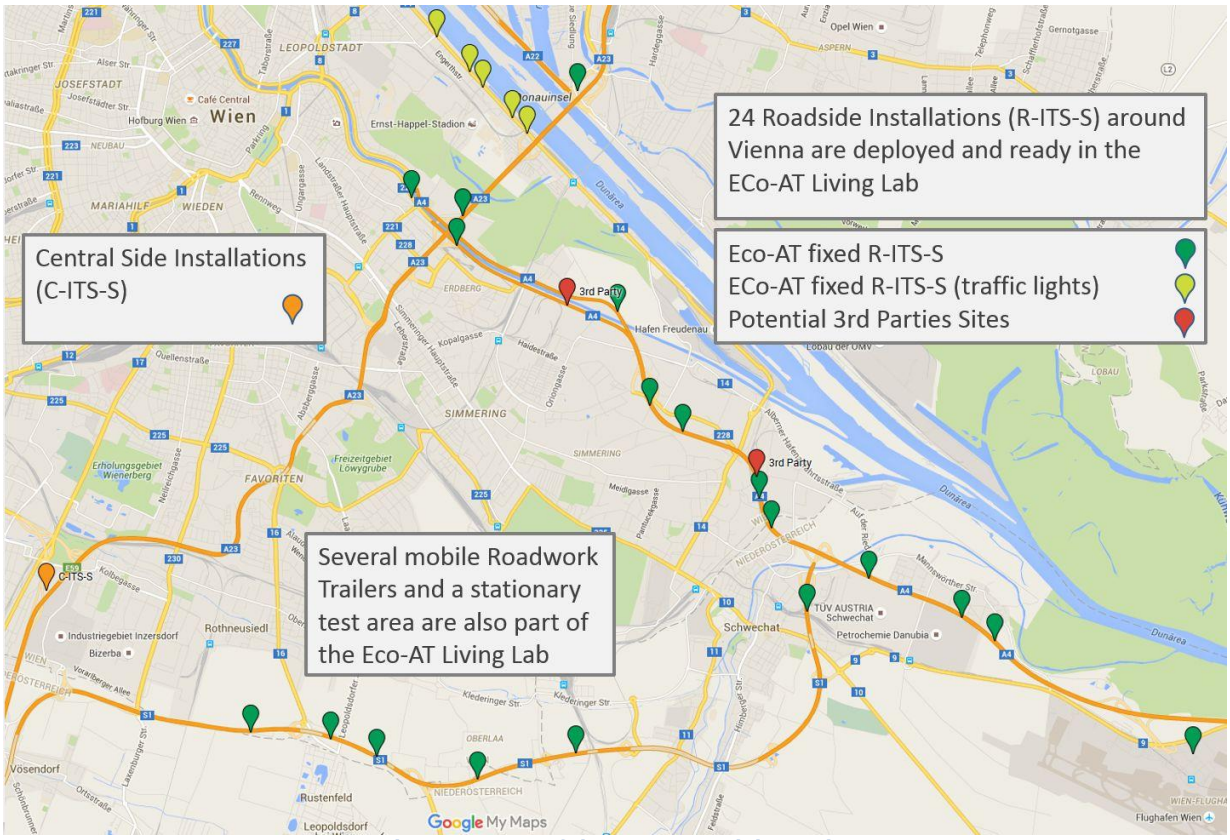


Figure 2: Map of the ECo-AT "Living Lab"

The “Living Lab” has been used for six official Test Cycles with OEMs and supply industry within the ECo-AT project, successfully verifying the Eco-AT specifications. Three “virtual” Test Cycles have been organized, using recorded data (captures) from the “Living Lab”, with the aim of verifying message sets in laboratory tests. Furthermore, three “physical” Test Cycles have been executed, each of them lasting three days, demonstrating all ECo-AT use cases on a parking lot and in the “Living Lab”. Participants of these tests included Hyundai, Opel, Honda, Volkswagen, Volvo Trucks, Fiat / CRF, Aricent, DENSO, Commsignia, Cohda Wireless

and Hyundai Mobis. All of them were able to receive and (in various degrees) successfully interpret the ECo-AT use cases and message sets.

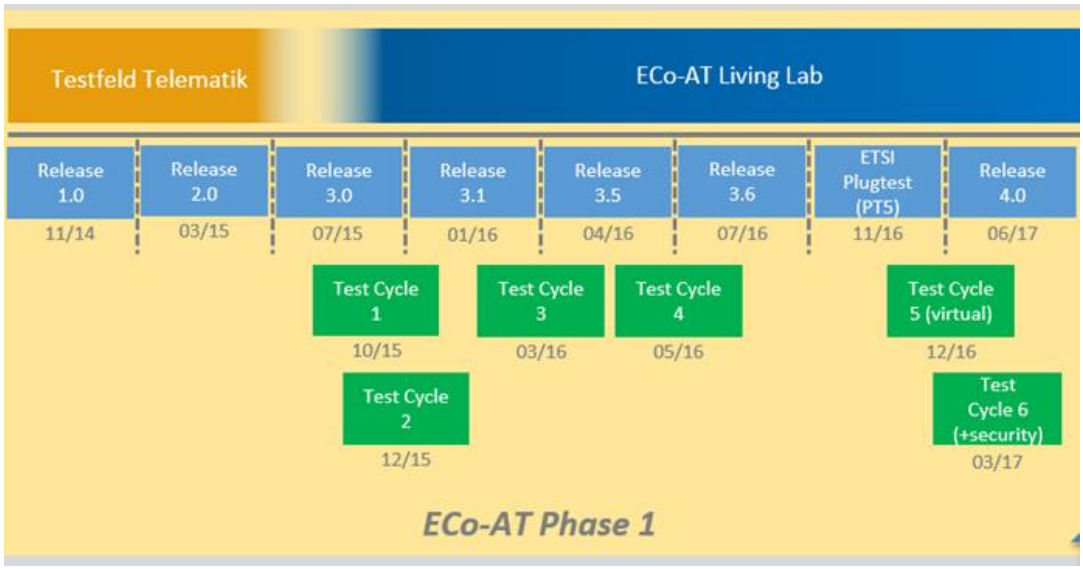


Figure 3: Overview on ECo-AT Specification Releases and Test Cycles

Figure 4: Participants in ECo-AT Test Cycle 6 in Vienna (March 2017)

France

SCOOP@F pilot sites

The SCOOP@F project has deployed amongst 5 pilot sites (see maps) about 200 road side units connected to traffic control centres.
Each pilot site has kept some road side units for validation purposes connected to mock-up traffic control centres to be able to test any new developments.
The road operators also have at their disposal equipped road operator vehicles (some kept for validation purposes) to test specific road operator vehicles use cases (such as winter maintenance for example). About 200 vehicles are equipped in total amongst the different pilot sites.
All those equipments are connected either to a production PKI for deployment equipments or to a validation PKI for test purposes.

The deployed use-cases so far are the following:

- Data collection: position/speed/direction, events detected, events declared
- Road works warning:
  - Planned road works,
  - Slow moving maintenance, winter maintenance,
  - Road operator vehicle approaching, rescue and recovery work in progress
- Hazardous location notification:
  - Slippery road, bad visibility, extreme weather condition
  - Animal on the road, human presence on the road, obstacle on the road, unmanaged blockage of the road
  - Accident, stationary vehicle, end of queue

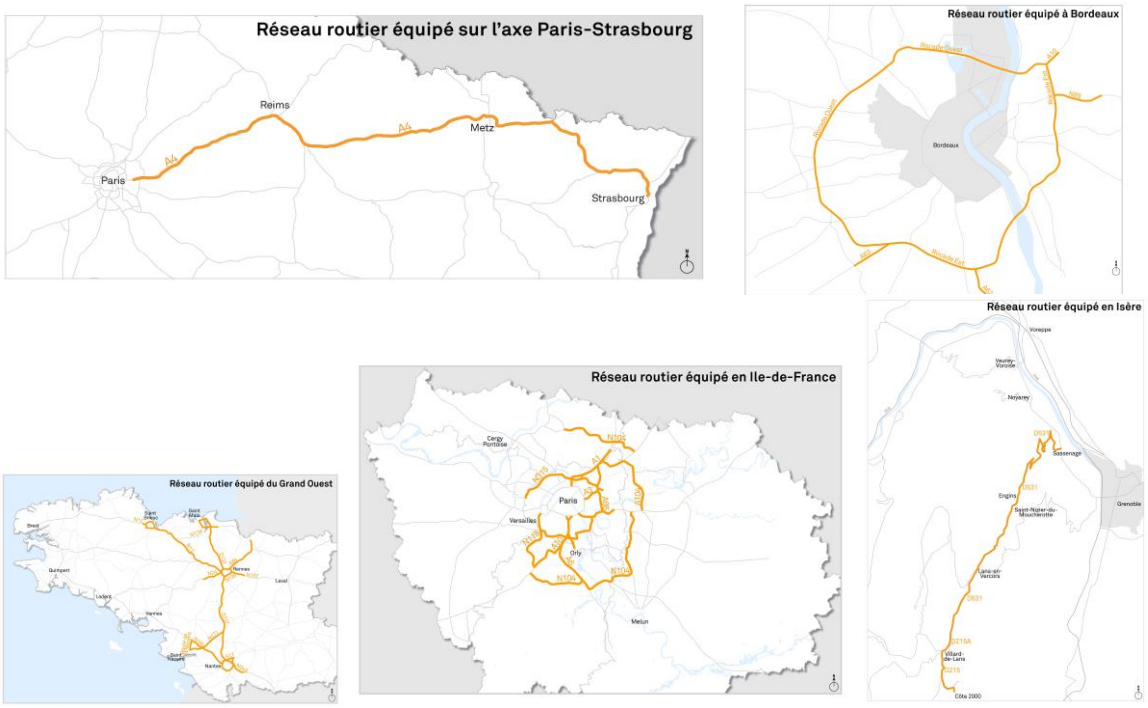
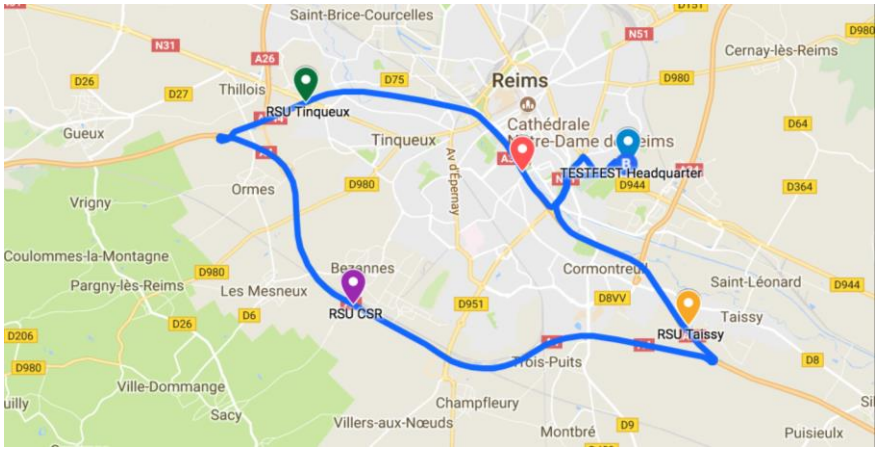


Figure 5: SCOOP@F pilot sites

Figure 6: Participants to tests on the West pilot site in July 2016

InterCor France TestFest

For the Testfest planned in the scope of the InterCor project, a specific site around Reims has been chosen and planned to deliver specific security test cases.



C-Roads France

With the C-Roads France and the InterCor project, France will have a solid infrastructure to test new use cases that it is willing to develop.

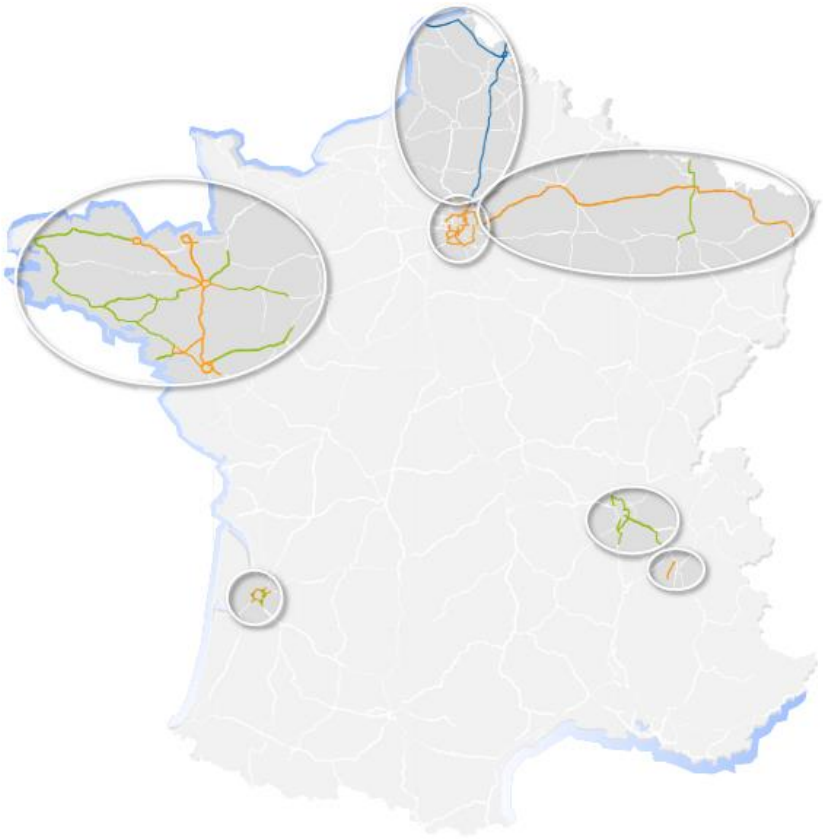


Figure 7: French pilot sites

Germany

Hessian Pilot Site

The Dynamic Road Infrastructure Vehicle Experimental (DRIVE) Center Hessen as the logistic of test data and the cooperative traffic control centre for testing V2X field contains following implementations:

- direct connection to the Traffic Control Centre
- control room for 4 operators
- workplace for 6 traffic engineers
- server infrastructure for ICS development
- communication network with internet access for data exchange between ITS roadside station (IRS) and ITS central station (ICS) and for software development
- provision and preparation of infrastructure-related data for C2X communication (fused traffic situation for the entire trial area, information on roadworks, control conditions of dynamic traffic signs, diversion strategies)
- collection and further processing of traffic-related data from vehicles (vehicles positions and speeds, traffic fusion, detected events by vehicles)
- IRS monitoring tool
- test control tool

The DRIVE Testsite Hessen for connected and automated traffic (cooperative roadside testsite in the Frankfurt Rhein-Main Metropolitan Region) consists following roads:

- the motorways A 3, A 5, A 661 and the federal roads B 3 and B 455 (total length of already covered network: 200 km)
- test gantry over BAB A 5 with access from the Traffic Control Centre Hessen site for device testing

Traffic lights in the Frankfurt Rhein-Main Metropolitan Region are also already implemented for the GLOSA testsite. 100 IRS with energy and data supply were installed in the DRIVE Testsite Hessen during previous projects. A small number of IRS have been damaged due to accidents and removed, the remaining IRS are still on the site. The C-Roads specific IRS will replace IRS from former research projects. Furthermore, 12 warning trailers are equipped with IRS for short-term roadworks.

Various development devices for I2C communication and a V2X enabled test vehicle can also be used for further developments.

Lower Saxony Pilot Site

The existing R&D test area “Application Platform for Intelligent Mobility (Anwendungsplattform Intelligente Mobilität)” focusses on the urban area in the city of Brunswick and serves as a platform for application-focused science, research, and development in the field of intelligent mobility services. The test field is extended to federal roads and motorways between Hannover, Brunswick and Wolfsburg under the lead of the Ministry for Economy, Labour and Transport of Lower Saxony (Niedersächsisches Ministerium für Wirtschaft, Arbeit und Verkehr) and the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt). The pilot activities will be implemented on a part of this test field, which is located on the North Sea-Baltic and Orient/East-Med corridor. More specifically, the activities will be implemented on the A2 motorway sections near Brunswick, as illustrated in figure 5.

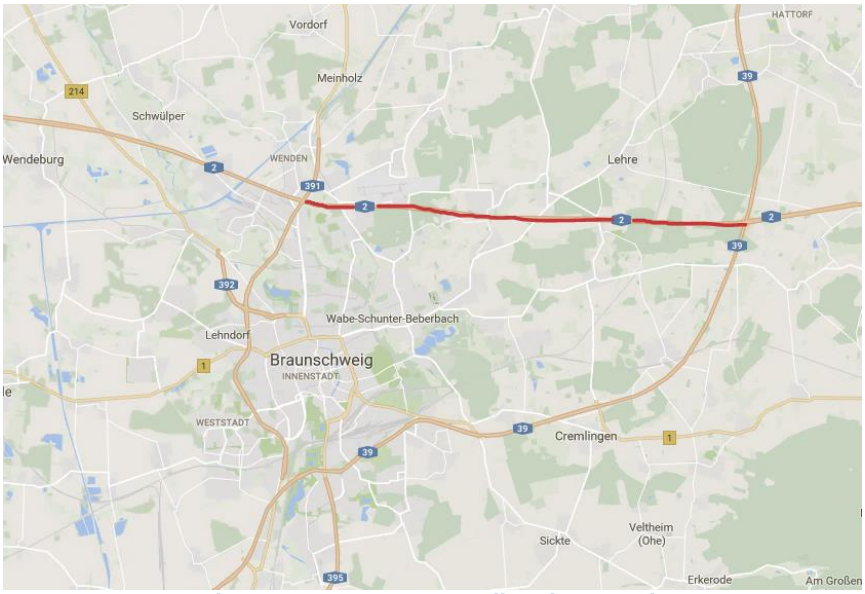


Figure 8: Lower Saxony pilot site stretch

The activities for the pilot are implemented as planned. Since the grant agreement and the kick-off meeting for the pilot took place in November and December 2016 respectively, the deployment and testing activities have not started yet. As proposed in the document "Lower Saxony – Pilot Organisation and Deployment Plan_v1.1", the deployment of the required system, infrastructure and the three services are scheduled to start in 2018. The general plan is as follows:

- One TCC, one C-ITS-S, two V-ITS-Ss and three R-ITS-Ss will be deployed in 2018.
- By the end of 2018, the "Slow or Stationary Vehicle Ahead Warning" service will be implemented. Subsequently, "In-Vehicle Signage" as well as "Probe Vehicle Data" services will be implemented by the end of 2019.

The entire ITS system in Lower Saxony is expected be operational by the end of 2019. The demonstration will be held until 30th September 2020.

The Netherlands

Until March 2017 the Dutch C-ITS Corridor project has implemented four large-scale so-called "pre-deployments" (tests) on various and for the Netherlands typical, stretches of the Dutch section of the international Cooperative ITS Corridor. These tests provided input to the Corridor-project team to finalise the technical specifications of the services. For pre-deployment 1, in which fixed Roadside Units (RSUs) were installed on gantries of the existing motorway management system, a representative pre-deployment site has been created on the A16 motorway near Dordrecht.[1]

This site was the basis for the test site for the first InterCor TestFest, the TestFest ITS-G5 in July 2017. The following table summarizes the services to be tested in the scope of InterCor. The scope of the TestFest ITS-G5 is highlighted.

Table 1: InterCor services (scope ETSI-G5 TESTFEST highlighted)

Services	The Netherlands	France	Belgium	UK
In vehicle signage	x	x	(x)	x
Probe data	x	x		x
Road works warning	x	x	x	x
GLOSA	x	x	x	x
Multimodal cargo transport optimisation	x	x		
Truck Parking	x	x		
Tunnel logistics	x		x	

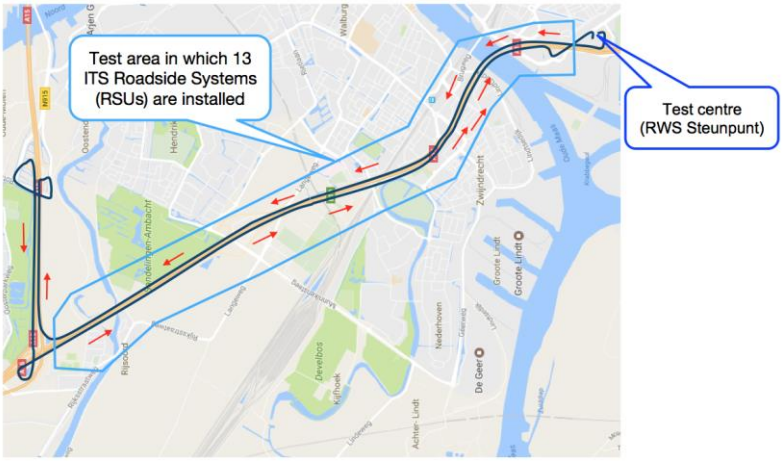
The InterCore TestFest ITS-G5 was a great success. For 4 days 20 participants, including the automobile industry, from all over Europe validated their implementations of the services. The TestFest for instance for the first time demonstrated In-Vehicle Signage in real life. The TestFest on the one hand resulted in an improved profile (now taken up by C-Roads) and on the other hand provided insight on several functional, technical and human-factor issues which need further study.

[1] Note that the Netherlands holds more test sites (e.g. the on the A58) then described here.

The TestFest test centre is a temporary facility located at a permanent Rijkswaterstaat Road Maintenance facility (called 'Steunpunt') in the city of Dordrecht, south of Rotterdam. The test centre is next to the open road test site on the A16 motorway and directly located near the exit and entrance to the A16. The test centre has a service area where test vehicles can be prepared and serviced.

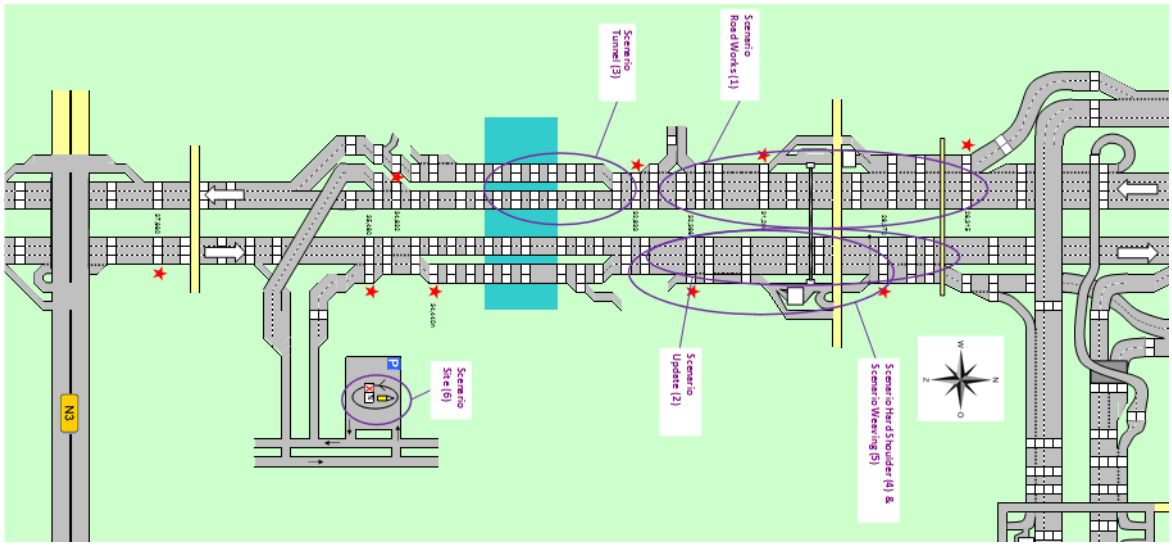
Fixed WiFi-P RSUs (beacons) have been placed on strategic locations on the A16, at positions compliant with the Dutch C-ITS Corridor specification 'placement guideline RSU'. All RSUs were mounted on gantries. The TestFest did not use RSUs mounted on trailers.

The test site allows testing of the services Road Works warning (RWW), In-Vehicle Signage (IVS), Collision Risk Warning (CRW) and Probe Vehicle Data (PVD, based on CAM aggregation). The RSUs send detailed information based on DENM and IVI, such as location of the road works, available lanes and maximum permitted speed to passing vehicles with a compatible Onboard Unit and vice versa collect the CAM messages from passing vehicles. Simultaneously logging data was collected.



The test site track stretches over 17 kilometres and has been equipped with 13 fixed RSUs, mounted on existing gantries. These RSUs were connected to a Central Unit based on a 3G-network connection. The infrastructure is suited to test the services (use cases) for both driving directions simultaneously.

The test site allows testing on three levels. The desk-tests are performed inside the offices of the test site, allowing participants to perform initial tests such as debugging of their equipment. Lab-tests are performed outside the test centre, allowing participants to drive on the test site premises at low speeds for short distances along a Roadside Unit in order to test proper functioning of their equipment in an open-air 'laboratory' environment. Open-road-tests are performed on an actual motorway, the A16 from Dordrecht to Rotterdam. These tests allow participants to test their equipment in a real live environment.



The test site allows testing with both 'real' (e.g. real-life road works) as well as 'virtual' (supported by a photo-script depicting imaginary trailers on the road) scenario's. For the TestFest 8 scenarios were defined in advance.

Czech Republic

The Road and Motorway Directorate of the Czech Republic (RSD CR) deployed a project called “Cooperative ITS Corridor Mirošovice – Rudná” in 2017. The C-ITS system operates on certain parts of the D0, D1 and D5 motorways around the City of Prague in total length of 48 kilometres. Total of 29 stationary RSU units have been placed on VMS gantries and poles along the motorway, together with 20 mobile units installed on warning trailers, and 28 on-board units in maintenance vehicles. Roadside stations are also equipped with Bluetooth and WiFi detectors to enhance the quality of the probe vehicle data service. The system is operated via dedicated C-ITS back office which serves a base stone for further C-ITS deployments on the Czech motorway network. Communication is based on standardized ITS-G5 technology (CAM, DENM and IVI message sets are currently in place), with back-up cellular communication used mainly for service purposes.

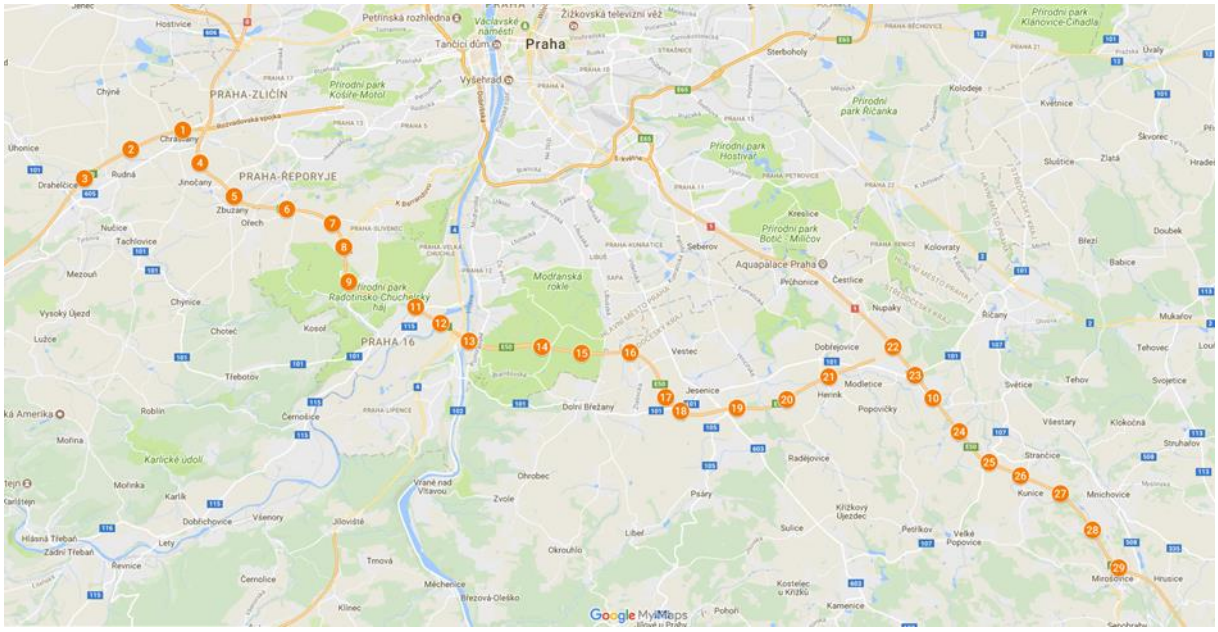


Figure 9: Map of the roadside units installed on Prague bypass and connecting motorways sections around Prague

The system currently provides the following services:

- Probe Vehicle Data (incl. related travel times provided via IVI messages to the drivers)
- Road Works Warning (DENM messages sent from warning trailers both in standalone and connected modes)
- In-Vehicle Signage (data from VMS gantries are converted into IVI messages and broadcasted via RSUs)
- Co-existence with 5,8 GHz tolling system (CAM messages with special data fields are being sent from nearby RSUs)

The system is now extensively used both for internal testing of Road and Motorway Directorate, as well as for external partners from the industry. ŠKODA AUTO regularly tests its technology on the site often with the assistance of RSD CR vehicles and trailers. Furthermore several ITS industry stakeholders have reported to had used the system for functional, technical and interoperability testing of their equipment. The project is also used as a testbed for C-ROADS implementations and the C-ITS back office will be further develop to manage other C-ITS installations and use cases deployed within C-ROADS.
Furthermore ŠKODA Auto a.s. as an associate partner of C-ROADS Czech Republic has been developing a test platform compatible with the C-ITS declared in project. Platform is including flotilla of testing cars connected to the ŠKODA back office which allows to receive and to send C-ITS messages from/to infrastructure as well as to others cars around.

3. Current status of the C-Roads deployments

The Austrian Pilot site

The planned C-ITS deployment in Austria focus on the specifications which were developed in ECo-AT phase 1. The day 2 Use Cases are currently under definition for CAD on the test stretch for Automated Driving in Graz. The start of a detailed planning for 802.11p procurement is on-going and will result in the start of the tender procedure in autumn 2018. C-Roads release 1.1 will be the basis for the procurement.

The Belgium (Flanders) Pilot site

Currently everything at the Belgium/Flanders pilot site is going on as planned. The plans related to 3G and 4G (cellular) are on track. The Belgium pilot site is planning to have around 1000 test drivers. In early 2019 the pilot should start.

The Czech Pilot site

The common system specifications are prepared and agreed by all Czech partners. Technical specifications for tenders within individual pilot sites are being elaborated and in some cases already finalised. First tenders for deployment will be launched in Q1/2018, and all of them shall be finalised by end of the year. The use case for railway level crossings were already virtually tested, and furthermore selected public transport vehicles (trams) were prepared for C-ITS in-vehicle unit installations. All C-Roads partners are invited to test existing ITS-G5 equipment on the Czech pilot sites.

The French Pilot site

French ministry is working close together with the car manufactures (Renault, Peugeot) who are already selling SCOOP@F vehicles. C-Roads France is extending SCOOP@F also in the urban area. The services should be deployed by end of 2019.

The German (Hessia, Lower Saxony) Pilot site

Germany has two pilots one in Hessen and another in Lower Saxony. For Hessen the tender will be launched in 2018 and the first bundle should be deployed by end of 2018. The second bundle should follow by end of 2019. Lower Saxony will follow a couple of months later.

The Dutch Pilot site

In June 2017 the Dutch had a Testfest for ITS-G5. There are discussions on-going how to integrate the new implementations in exiting systems. In addition the C-ITS deployment plans are under discussion.

The Slovenian Pilot site

The first C-ITS tender (LTE) is done and already awarded (DARS did it) while the second will be published in Q4 2017 (5,9 GHz band).

The UK Pilot site

The main UK pilot (20km section) includes motorway and interurban sections. The procurement process is on the way and should be published in the first half of 2018. The deployments should follow in 2019 including an ITS-G5 as well as a hybrid solution.